11. (Amended) A high frequency piezoelectric resonator according to claim 8, wherein

said at least one second electrode is divided into a plurality of portions; and

adjustment of frequency is performed on said at least one second electrode so that frequency of each one of electrode portions of said at least one of the divided second electrode has a uniformity.

Please amend claim 12 as follows:

12. (Amended) A high frequency piezoelectric resonator according to claim 5 or 6, wherein

said at least one second electrode is divided into a plurality of portions; and

adjustment of frequency is performed on said at least one second electrode so that frequency of each one of electrode portions of said at least one of the divided second electrode has a uniformity.

REMARKS

Applicant has amended claims 1, 2, 5, 7 and 9-12, amended the specification and the drawings. Applicant respectfully submits that these amendments to the claims, specification and drawings are supported by the application as originally filed and do not contain any new matter. Accordingly, the Office Action will be discussed in terms of the specification, drawings and claims as amended.

The Examiner has objected to the drawings stating that the drawings must show each and every element of the claimed invention and particularly must show the construction of the secondary electrode in claim 7. By the Letter to the Chief Draftsperson submitted for the Examiner's approval, Applicant has amended the drawings to include the particular elements of the original claim 7 and has further amended the specification on pages 10, 17 and 18 to show the elements of the original claim 7. Accordingly, Applicant respectfully requests that the Examiner withdraw his objection.

The Examiner has rejected claims 2, 5, 7 and 9-12 under 35 USC 112, second paragraph, as being indefinite. Applicant has amended the claims and respectfully submits that these claims now comply with 35 USC 112, second paragraph.

The Examiner has rejected claims 1, 2, 3, 7 and 9 under 35 USC 103 as being obvious over Tomita et al. in view of Novikov and Kaida, stating that Tomita et al. discloses a piezoelectric device having a piezoelectric plate 1 with a main electrode 2a, an electrode 2c surrounding the edge of the main electrode with a gap in between, but does not disclose that the electrodes are made of different materials or that a plurality of electrodes surround the main electrode; Novikov discloses the purpose of improving the accuracy of measurement of amplitude frequency over a wide range of frequency spectrum accomplished by making the electrodes of different materials having different densities; Kaita discloses the purpose of ensuring enough bandwidth for a working piezo resonator to surround the main electrode 28c with a plurality of second electrodes 31B and 29; and it would have been obvious to modify the device of Tomita et al. in view of the teachings of Novikov and Kaida.

Applicant has carefully reviewed Tomita et al. and respectfully submits that in Tomita et al., the main electrode 2a and the second electrode 2c are of the same material and have the same thickness and density. As a result of this construction and as required by Tomita et al., when the cutoff frequency of the main electrode, the gap and the second electrode are respectively set to be f_1 and f_2 and f_3, then the relationship $f_1 < f_3 < f_2$ does not exist. As a result, the functions and advantages derived from these structural differences are also different from Applicant's invention. In addition, Tomita et al. discloses that it traps the symmetric 0th mode S_0, the anti-symmetric 0th mode A_0 and the symmetric 1st mode S_1. In contrast thereto, in Applicant's invention with $f_1 < f_3 < f_2$, the anti-symmetric 0th mode A_0 is avoided from being trapped.

Applicant has further reviewed Novikov and respectfully submits that Novikov relates to a pressure sensor. In order to increase the sensitivity of the sensor in Novikov, one electrode formed on the piezoelectric plate of a piezoelectric resonator is divided in half without providing a gap in between. In other words, in Novikov there are two regions 3 and 4 and these regions are merely made of materials of different densities and there is no second electrode provided to surround the main electrode with a gap in between. Accordingly, Applicant respectfully submits that since the devices and functions of Novikov and Tomita et al. are different, one of ordinary skill in the art would not be motivated to apply the teachings of Novikov to the device of Tomita et al.

Applicant has also carefully reviewed Kaida and respectfully submits that in Kaida three resonators are merely closely provided with slits (air) in between. The vibration energy of the

resonator 28 does not affect the resonators 26 and 27 and similarly the resonators 26 and 27 do not affect the resonator 28. In other words, the object and structure of Kaida is to make the passing band broader and utilizes a slit to achieve this result. Applicant respectfully submits that this slit of Kaida is substantially different in construction and function from the gap between the main and second electrodes required by Tomita et al. and Applicant's invention. Therefore, Applicant respectfully submits that one of ordinary skill in the art would not be motivated to apply the teachings of Kaida to the device of Tomita et al.

In view of the above, therefore, Applicant respectfully submits that not only is the combination suggested by the Examiner not Applicant's invention but also the combination suggested by the Examiner is not suggested by the art and one of ordinary skill in the art would not be motivated to make the combination suggested by the Examiner. Therefore, Applicant respectfully submits that claims 1, 2, 3, 7 and 9 are not obvious over Tomita et al. in view of Novikov and Kaida.

The Examiner has rejected claims 4, 8, 10 and 11 under 35 USC 103 as being obvious over Tomita et al., Novikov and Kaida and further in view of Wajima, stating that the combined piezoelectric resonator discloses all of the limitations except that the electrodes have an elliptical configuration; Wajima discloses for the purpose of suppressing undesired spurious vibrations, the electrodes are formed in an elliptical configuration; and it would be obvious to one of ordinary skill in the art to modify the combination of Tomita et al., Novikov and Kaida with view of the teachings of Wajima.

In reply thereto, Applicant would like to incorporate by reference his comments above concerning Applicant's invention and Tomita et al., Novikov and Kaida. In addition, Applicant has carefully reviewed Wajima and respectfully submits that Wajima relates to an energy trapping type piezoelectric resonator that uses a third harmonic wave of thickness extensional vibration. By way of differentiating the relationship or the outer size of the electrodes of the diameters a and b of the main surfaces in Wajima, the fundamental harmonic wave of the thickness extensional vibration can be easily leaked out of the vibration region, thus suppressing the spurious signal caused by the fundamental harmonic wave. Applicant respectfully submits that the resonator of Wajima and Tomita et al. is of different technologies and the structure and resulting function and advantage are different and one of ordinary skill in the art would not be motivated to utilize the teachings of Wajima in Tomita et al.

In addition to the above, in Applicant's invention, so as to suppress the spurious vibration that appears in the higher region of a resonance frequency of a piezoelectric resonator, an excitation main electrode and a second electrode that surround the main electrode with a gap in between are formed on the main surface of the piezoelectric plate and further such main and second electrodes are formed of different materials that have different densities, thus making only the symmetric 0th mode a trapping mode and not making other unnecessary vibration modes a trapping mode. As a result, the main electrode of Applicant's invention is shaped elliptically, thus providing a piezoelectric resonator whose capacitance ratio is minimal by way of displacement distribution of the thickness shear vibration mode. Applicant respectfully submits that such an operation is also substantially different from that suggested by Wajima and one of ordinary skill in the art would not look to Wajima to create Applicant's invention.

In view of the above, therefore, Applicant respectfully submits that not only is the combination suggested by the Examiner not Applicant's invention but also the combination suggested by the Examiner is not suggested by the art and one of ordinary skill in the art would not be motivated to make the combination suggested by the Examiner. Therefore, Applicant respectfully submits that claims 4, 8, 10 and 11 are not obvious over Tomita et al., Novikov and Kaida and further in view of Wajima.

The Examiner has rejected claim 5 under 35 USC 103 as being obvious over Tomita et al. in view of Dydyk, stating that Tomita et al. discloses a piezoelectric device having a piezoelectric plate 1 with a main electrode 2a, an electrode 2c surrounding the edge of the main electrode with a gap in between, but does not disclose that the main surface has a recess corresponding to a thin portion; Dydyk discloses for the purpose of providing a robust resonator having high quality factor and low insertion loss that a piezoelectric plate can have a recess to thereby form a thin portion; and it would be obvious to modify Tomita et al. in view of the teachings of Dydyk.

In reply thereto, Applicant would like to incorporate by reference his comments above concerning Applicant's invention and Tomita et al. In addition, Applicant has carefully reviewed Dydyk and respectfully submits that in Dydyk an acoustic resonator which has electrodes 19 and 12 formed on both sides of a piezoelectric resonator layer 14 with no recess formed therein is fixed to a silicon plate 11, that has a cavity. The piezoelectric resonator 14 has one pair of main electrodes and in Fig. 1 of Dydyk it shows that the conductor 215 surrounds the

main electrode 17; however, in Dydyk the conductor 215 is actually a heater that protects the piezoelectric resonator layer 14 and is not a second electrode in the sense of Applicant's invention and is a different structure. Accordingly, Applicant respectfully submits that not only does Dydyk not show a recess but also does not show a structure which has first and second electrodes.

In view of the above, therefore, Applicant respectfully submits that not only is the combination suggested by the Examiner not Applicant's invention but also the combination suggested by the Examiner is not suggested to one of ordinary skill in the art. Therefore, Applicant respectfully submits that claim 5 is not obvious over Tomita et al. in view of Dydyk.

The Examiner has rejected claim 6 under 35 USC 103 as being obvious over Tomita et al. and Dydyk and further in view of Wajima, stating that the combination of Tomita et al. and Dydyk show all of the elements of Applicant's invention except for the electrodes having an elliptical configuration; Wajima discloses the elliptical configuration; and it would be obvious to one of ordinary skill in the art to modify the combination of Tomita et al. and Dydyk to have an electrode with an elliptical configuration as disclosed by Wajima.

In reply thereto, Applicant would like to incorporate by reference his comments above concerning Applicant's invention, Tomita et al., Dydyk and Wajima and respectfully submits that the combination suggested by the Examiner is not only not Applicant's invention but also is not suggested to one of ordinary skill in the art. Therefore, Applicant respectfully submits that claim 6 is not obvious over Tomita et al. and Dydyk and further in view of Wajima.

The Examiner has rejected claim 12 under 35 USC 103 as being obvious over Tomita et al. and Dydyk and further in view of Kaida, stating that the combination of Tomita et al. and Dydyk show all elements of claim 12 except for the electrode divided into a plurality of portions; Dydyk discloses dividing the electrode into a plurality of portions; and it would be obvious to one of ordinary skill in the art to modify the combination of Tomita et al. and Dydyk in view of the teachings of Kaida.

In reply thereto, Applicant would like to incorporate by reference his comments above concerning Applicant's invention, Tomita et al., Dydyk and Kaida and respectfully submits that not only is the combination suggested by the Examiner not Applicant's invention but also the combination suggested by the Examiner is not suggested to one of ordinary skill in the art.

Therefore, Applicant respectfully submits that claim 12 is not obvious over Tomita et al. and Dydyk and further in view of Kaida.

Attached hereto is a marked-up version of the changes made to the specification, drawings and claims by the current amendment. The attached page is captioned "Version with markings to show changes made."

Applicant further respectfully and retroactively requests a three month extension of time so as to respond to the Office Action. Please charge Deposit Account No. 11-1445 in the sum of $920.00 as the fee.

In view of the above, therefore, it is respectfully requested that this Amendment be entered, favorably considered and the case passed to issue.

Please charge any additional costs incurred by or in order to implement this Amendment or required by any requests for extensions of time to KODA & ANDROLIA DEPOSIT ACCOUNT NO. 11-1445.

Respectfully submitted,

KODA & ANDROLIA

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William L. Androlia
Name

_____ 11/1/2002
Signature Date

Application No. 09/746,600

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

Page 10, fourth full paragraph, has been amended as follows:

[Fig. 4 is a] Figs. 4(a) and 4(b) are plan [view] views illustrating the construction of two versions of a second embodiment of the invention;

The paragraph extending from pages 17 and 18 has been amended as follows:

[Fig. 4 is a] Figs. 4(a) and 4(b) are plan [view] views illustrating the construction of two versions of a second embodiment of the invention. In a first version of this second embodiment in Fig. 4(a), the second electrode 5 of Fig. 1 is divided to thereby provide divisional electrodes 5', 5', ..., and lead electrodes T1, T2, T3, and T4 are provided with respect thereto. In case that there are slight irregularities or unevenness in the flatness and the parallelism of the crystal plate 1, or in case that there is non-uniformity in the films of the electrodes, the production of spurious due to the anti-symmetric mode can be suppressed by adjusting the frequencies of the second electrode 5', 5', ... For instance, in case that spurious has occurred in a high frequency resonator that has been manufactured, the following countermeasures can be taken. Using the terminals T1, T2, T3, and T4 illustrated in Fig. [4] 4(a), there is measured the frequency of such resonator. And only if finely adjusting the high-value portions of this frequency by methods of evaporating, etc. it would be sufficient. Similarly to Fig. 4(a), in the second version of Fig. 4(b), a plurality of second electrodes 5'b are provided on the crystal plate 1 opposing the plurality of second electrode 5' together with another electrode 7b.

IN THE CLAIMS:

Claim 1 has been amended as follows:

1. (Amended) A high frequency piezoelectric resonator, the piezoelectric resonator including a piezoelectric plate having disposed on its main surfaces, respectively, mutually opposing main [electrodes] electrode for the excitation[, a pair of] and at least one second [electrodes being each] electrode disposed surrounding the peripheral edge of its

corresponding main electrode with a gap in between, wherein:

the material of the main electrode and the material of the second electrode are different from each other.

Claim 2 (amended) has been amended as follows:

2. (Twice Amended) A high frequency piezoelectric resonator according to claim 1, wherein the density of the material of the second electrode is made lower than that of the main electrode; and wherein $\leq f_1 \leq f_3 \leq f_2$ is satisfied in which a cutoff frequency [dimensional values] of the main electrode is f_1, a cutoff frequency of the gap is f_2, and a cutoff frequency of the second electrode is f_3 [, and gap are set so that an anti-symmetric 0th mode does not become a trapped mode].

Claim 5 has been amended as follows:

5. (Amended) A high frequency piezoelectric resonator including a piezoelectric plate, one main surface of the piezoelectric plate being recessed to thereby form a thin portion therein, the main surface opposing the recess corresponding to the thin portion having [formed] thereon at its central portion a convex portion formed integrally with the piezoelectric plate, the convex portion having formed thereon a main electrode for the excitation, a lead electrode being extended from the main electrode toward an edge of the plate, a second electrode being so provided as to surround the main electrode and the lead electrode with a gap in between, the piezoelectric plate having applied on a recess side thereof an entire electrode.

Claim 7 has been amended as follows:

7. (Amended) A high frequency piezoelectric resonator according to claim 1 or 2 [claims 1 to 6], wherein

said at least one [the] second electrode is divided into a plurality of portions; and

adjustment of frequency is performed on said at least one second electrode so that [of these] frequency of each one of electrode portions of said at least one of the divided second electrode has a uniformity.

Claim 9 has been amended as follows:

9. (Amended) A high frequency piezoelectric resonator according to claim 3, wherein

said at least one [the] second electrode is divided into a plurality of portions; and

adjustment of frequency is performed on said at least one second electrode so that [of these] frequency of each one of electrode portions of said at least one of the divided second electrode has a uniformity.

Claim 10 has been amended as follows:

10. (Amended) A high frequency piezoelectric resonator according to claim 4, wherein

said at least one [the] second electrode is divided into a plurality of portions; and

adjustment of frequency is performed on said at least one second electrode so that [of these] frequency of each one of electrode portions of said at least one of the divided second electrode has a uniformity.

Claim 11 has been amended as follows:

11. (Amended) A high frequency piezoelectric resonator according to claim 8, wherein

said at least one [the] second electrode is divided into a plurality of portions; and

adjustment of frequency is performed on said at least one second electrode so that [of these] frequency of each one of electrode portions of said at least one of the divided second electrode has a uniformity.

Claim 12 has been amended as follows:

12. (Amended) A high frequency piezoelectric resonator according to claim 5 or 6, wherein

said at least one [the] second electrode is divided into a plurality of portions; and

adjustment of frequency is performed on said at least one second electrode so that [of these] frequency of each one of electrode portions of said at least one of the divided second electrode has a uniformity.